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Save Money With Good Air-Drying Practices For Hardwood Lumber

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This report is based on a preliminary study by the Utilization Department of the Arkansas Forestry Commission on air-drying operations at several hardwood lumber processing plants in Arkansas. This study was part of the Drying Improvement Program (DIP) being implemented by the Commission with assistance from the Resource Use Unit, Southeastern Area, USDA Forest Service.

DIP is designed to help mill owners and managers improve their practices of drying green lumber. Its objective is to recover greater volumes of usable wood products through increased processing efficiency. Improvements in drying practices should help reduce needless volume and value losses of lumber and thus moderate industrial demands on the standing resource.

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SAVE MONEY WITH GOOD AIR-DRYING PRACTICES FOR HARDWOOD LUMBER

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This report summarizes the findings of a study of air-drying operations at seven hardwood plants in Arkansas during 1979. The goals of this study were:

1) to determine quantitative measures of volume and value loss directly related to shrinkage and controllable seasoning defects in red oak lumber;
2) to identify these defects and measure their effect on lumber quality during the air-drying process; and
3) to recommend to individual hardwood plants, when appropriate, any improvements in present practices or yard conditions which would help reduce losses due to degrade.

Red oak was examined in this study because of its relatively high value and the large amounts processed each year throughout Arkansas. The oaks accounted for more than 60 percent of the State's harvest of nearly 483 million board feet (Int. ¼-inch scale) of hardwood sawtimber in 1977. Another reason was the relative degree of difficulty involved in trying to dry oak lumber with a minimum amount of seasoning degrade.

STUDY PROCEDURES

Eight samples of rough red oak lumber were chosen for study at seven hardwood plants that dry more than 35 million board feet of oak lumber annually. Two samples were taken at one plant that used two different yards to air-dry its lumber. Seven samples consisted of 4/4-inch stock and one sample was 5/4-inch oak.

Two hardwood plants were located in northern Arkansas, two were in central Arkansas, and three were in the southern part of the State. Four of the operations manufacture rough and finished oak lumber for secondary processing plants. Three operations buy green lumber for in-house drying and manufacture into flooring and furniture products.

At each study site, a representative sample of red oak lumber was first graded in the green condition by a district inspector of the National Hardwood Lumber Association (NHLA). The sample in each case was sufficient to make at least two stickered packages of lumber which were typical of other packages dried on that yard. After determining the grade and volume, each green sample was handled like the rest of the lumber in the yard.

The study team returned to reinspect each sample only when the samples had reached a moisture content of around 20 percent. During the final inspection, the grade and volume of each board were again determined and recorded by the NHLA inspector. If drying defects[2] were present, the grade of the board was recorded as found and also as it would be if the defects were disregarded. In such a case the grade change (if any) was recorded and the cause of degrade noted.

RESULTS

Table 1 summarizes data acquired for all eight completed studies. The difference between green volume and dry volume was attributed to shrinkage, primarily tangential shrinkage in board width. Volumes lost during drying were uniformly deducted from green volumes for each grade, based on the percentage lost. For example, 6.7 percent of the green volume in every grade of Sample No. 1 was deducted to compensate for the effects of shrinkage. The assumption was made that shrinkage is uniform across all grades. By factoring out the loss of volume due to shrinkage, direct comparisons between the grades of green and dry samples could be made and value losses by grade determined.

Table 1—Initial and final volumes, volumes lost in drying, and final moisture contents of all samples.

Sample no.	Initial green volume	Final dry volume	Volume lost in drying		Final moisture content*
	board feet			*percent*	
1	7,268	6,781	487	6.7	18
2	2,793	2,627	166	5.9	18
3	3,497	3,346	151	4.3	21
4	1,891	1,779	112	5.9	15
5	3,307	3,085	222	6.7	14
6	1,527	1,452	75	4.9	17
7	1,546	1,468	78	5.0	15
8	2,872	2,628	244	8.5	15
Totals	24,701	23,166	1,535		

*Average moisture content was determined by oven-drying method or use of electrical moisture meter.

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[2]Only end and surface check, sap stain, decay and sticker rot, end splits and cracks, and warp were considered as seasoning defects in this study. Mineral stain and ring shake were not counted as defects because yard managers cannot influence the occurrence or severity of these defects in lumber. Damage from insects was not significant in any samples.

*Table 2—Comparison of green volumes (shrinkage excluded) with actual dry volumes, by grade, for all samples.**

Sample no.	FAS		SEL		1 Com		2 Com		3 A		3 B		Cull		Total sample
	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry	
1	951	134	182	41	1,675	1,564	2,017	1,382	1,585	2,166	371	1,353	—	141	6,781
2	489	285	157	235	932	801	404	649	590	457	55	200	—	—	2,627
3	688	421	157	197	1,887	1,918	614	445	—	172	—	193	—	—	3,346
4	169	50	29	69	493	512	621	434	355	371	112	319	—	24	1,779
5	56	44	—	—	860	855	905	841	740	783	524	562	—	—	3,085
6	179	84	—	48	899	491	235	329	113	188	26	312	—	—	1,452
7	102	96	—	94	871	403	297	351	177	150	21	374	—	—	1,468
8	145	96	—	—	1,029	720	814	695	413	403	227	684	—	30	2,628
Total	2,779	1,210	525	684	8,646	7,264	5,907	5,126	3,973	4,690	1,336	3,997	0	195	23,166

*All volumes reported in board feet.

Table 2 compares actual air-dry volumes with green volumes adjusted for shrinkage. This table shows how volumes in each grade for each study changed as the samples dried on their respective yards.

A potential value for each grade was calculated by applying rough, air-dry 4/4-inch oak lumber prices to the adjusted green volumes of all samples. The *Lumberman's Market Report,* December 14, 1979, was the source for price information. Actual air-dry lumber values by grade were determined by applying the same prices to summed dry lumber volume. These calculations are summarized in table 3.

Table 3—Comparisons of actual dry with adjusted green volumes and values, all samples combined.

Grade	Adjusted Green Volume (BF)	Potential value ($)	Actual Dry volume (BF)	Actual Dry value ($)
FAS	2,779	$1,417.29	1,210	$ 617.10
SEL	525	262.50	684	342.00
1 Com	8,646	3,328.71	7,264	2,796.64
2 Com	5,907	1,075.07	5,126	932.93
3A Com	3,973	635.68	4,690	750.40
3B Com	1,336	133.60	3,997	399.70
Cull	—	—	195	—
Total	23,166	$6,852.85	23,166	$5,838.77

The difference between potential and actual dry values is the net value loss for all samples:

$6,852.85 (potential) – $5,838.77 (actual) = $1,014.08 (net)

In terms of dollar loss per thousand board feet, net value loss is equivalent to $43.77 per thousand board feet. This implies that for every thousand board feet dried on the eight yards, an average of almost $44 was lost because of seasoning degrade, using current market prices.

The average percentage value loss for all samples was calculated as the ratio of net value loss to total potential value, or:

$1,014.08 ÷ $6,852.85 = 14.8 percent

The percentage value loss for individual samples ranged from a low of 1.2 percent to a high of 24.6 percent.

Figure 1 illustrates the average difference between all green and air-dry samples in terms of grade yield percentages. The average potential value of all lumber inspected during the study was $295.81 per thousand board feet (value when green, with shrinkage excluded). Upon drying, the same volume was valued at $252.04 per thousand board feet, reflecting an average net loss of almost $44 per thousand board feet, all of which is directly related to seasoning degrade.

CONCLUSIONS

The results of this study indicate that seasoning degrade is taking a heavy toll on the potential value of oak lumber dried on the yards examined. For all combined samples, about one of every four boards was estimated to have dropped in value by at least one grade. More than one-fourth of all volume was affected by seasoning defect, in one form or another. These operations may be fairly typical of air-drying practices and yard conditions existing throughout the industry in Arkansas. Unfortunately, lumber values are being severely downgraded on a rather large scale as a result of indifference or lack of knowledge of better ways of air-drying lumber.

Some of the areas that need greater attention by yard foremen and mill managers are summarized on pages 3-6.

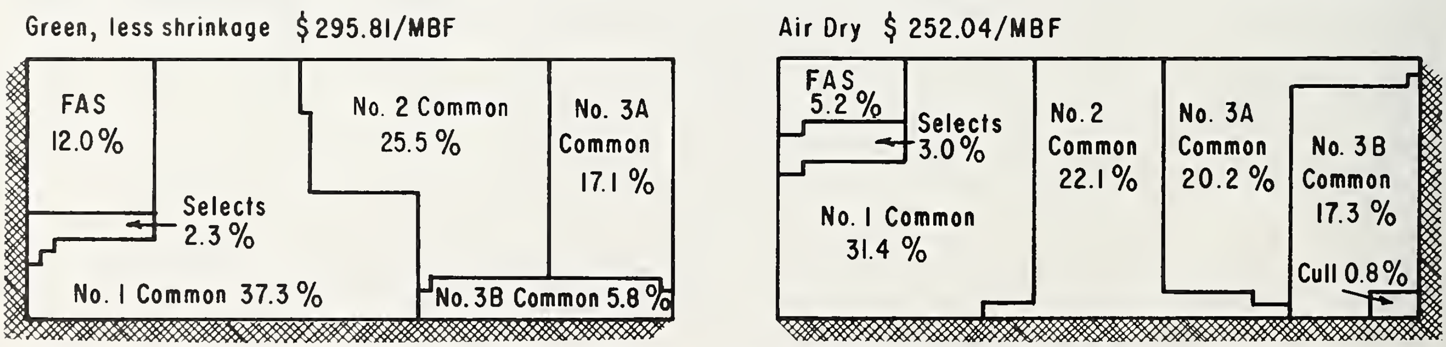

Figure 1.—Comparison of average grade yields of green and air-dry 4/4 red oak in 23,166 b.f. sample. (Dollar values calculated using December 1979 market prices.)

Figure 2.—Lumber degrade is much more likely in stacks where foundations do not provide adequate ground clearance and/or where vegetation obstructs air flow.

Stack Foundations and Vegetation

Though a high foundation that permits good air circulation in and around stack bottoms is very important for providing optimum drying conditions, most yards are discounting this fact. The average foundation at the yards examined allowed only 6 to 8 inches (15 to 20 cm) of ground clearance; several stacks appeared to have no foundation at all, with the bottom course of lumber in direct contact with the soil. See figure 2. The minimum recommended foundation height is 12 inches (30.5 cm), and should be 18 inches (46 cm) on yards with poor or only fair drainage. See figure 3.

In addition to insufficient ground clearance, various foundations were constructed of crossties and timbers showing signs of initial or advanced decay. See figure 4. Setting green lumber on such material ensures the loss of the bottom layer or two to decay or stain fungi.

Vegetation was a problem on three of the eight yards (figure 2). Weeds and grass 2 to 4 feet (91 to 122 cm) high around stack foundations reduce the ability of drying air to reach lumber in the bottom package. They also contribute to higher humidity conditions, thus increasing the chances for stain to develop. A well-timed application of herbicide is an easy, low-cost way to control this problem.

Drainage

Only two yards appeared to have drainage problems, where poor drainage permitted water to stand beneath or around stack foundations. Not surprisingly, both of these yards produced air-dried lumber that was significantly affected by stain and decay.

Standing water will normally reduce the drying rate of nearby stacks and increase the likelihood of damage because of stain. See figure 5. Drainage is especially critical on low-lying yards where air circulation is naturally impeded. In most cases drainage can be improved without a large investment of capital or labor.

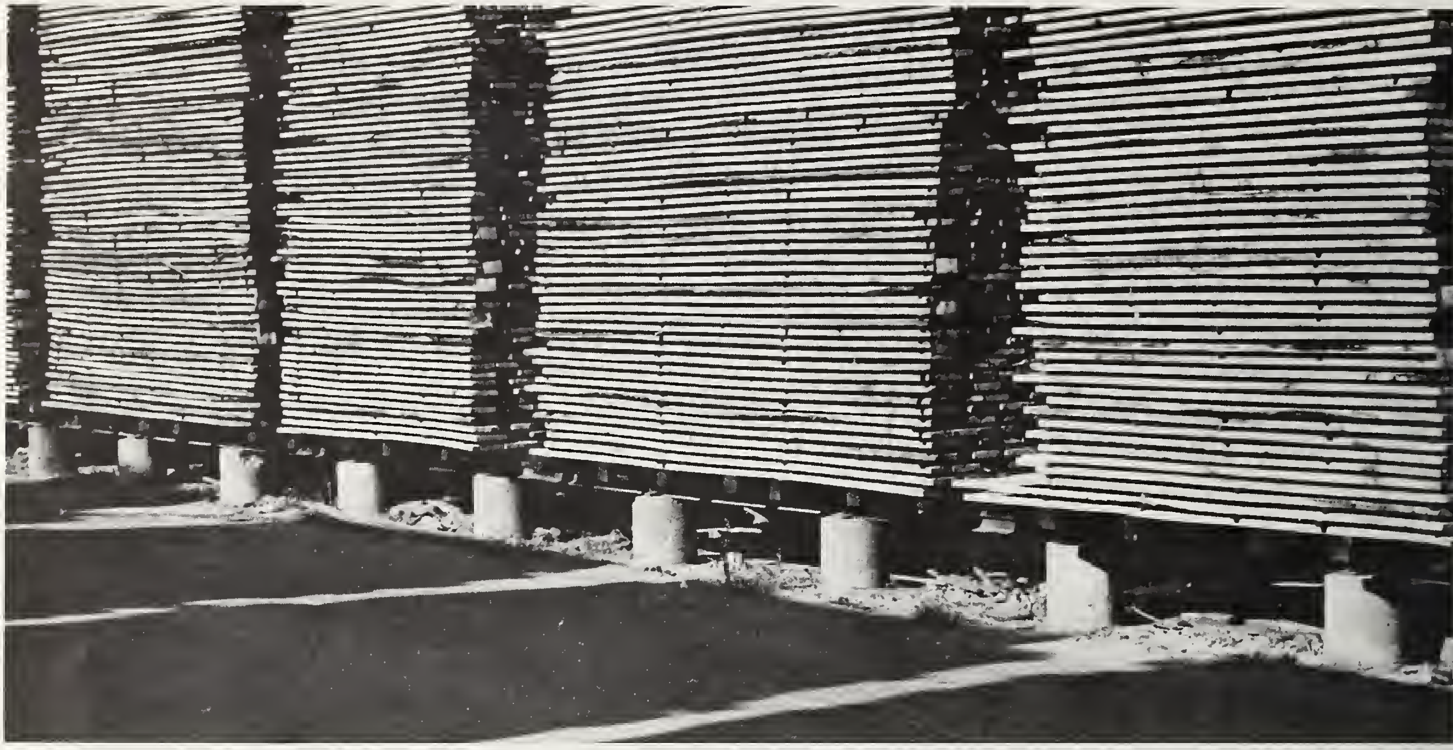

Figure 3.—Foundations that permit brisk air movement under lumber stacks help speed up the air-drying process and thus prevent the development of stain and decay in the lower courses of lumber.

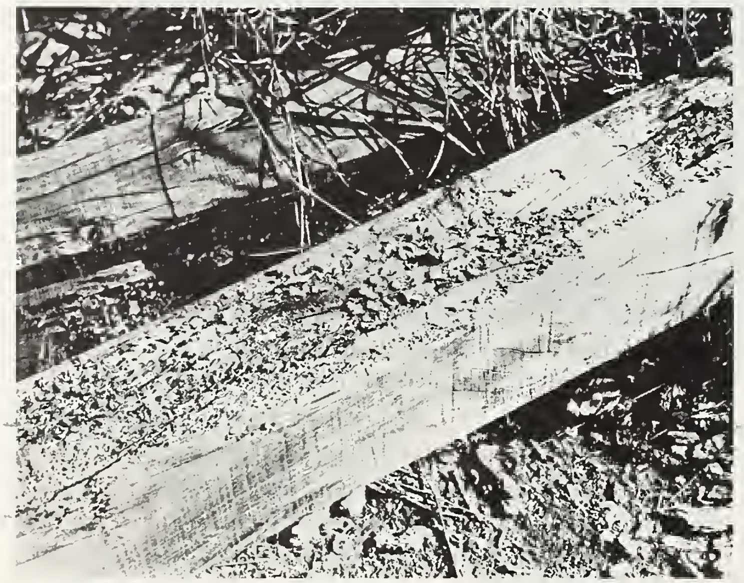

Figure 4.—Placing green lumber in contact with decaying foundation members is a sure way of inviting lumber degrade. As stack foundations represent a considerable capital investment, they should be well designed and made of materials that will contribute to long life and low maintenance costs.

Stack Covers

Where the output of air-dried lumber per acre of yard area must be fairly high and production fairly constant, stack covers can be economically justified, especially where upper grade stock is concerned. See figure 6. Air-drying research shows that raintight covers can save enough in lumber value and drying time for 4/4 No. 1 Common and better red oak to pay for the covers in as little as five or six uses.

In this study, however, only one operation was effectively protecting its stacks with a cover (in this case, rainproof paper). One operation used cull boards on top, but this practice does not prevent rain from penetrating the top layers and increasing the incidence of surface checks. When higher grades of lumber are placed on stack tops, some form of rain-tight cover should be used to help prevent recurring wetting and drying cycles in the upper courses. See figure 7.

This one practice could possibly be the most effective means of improving overall lumber value recovery during air-drying. The one plant using rainproof paper had a net value loss well below the average for all samples.

Stickers

Though sticker widths, thicknesses and lengths varied at most yards, the major area of concern is the condition in which stickers were being used. In half the samples inspected, rotten stickers quite often had infected the green lumber and drastically reduced value, especially in boards that initially graded No. 1 Common and better.

The solution to this problem is simply to stress to stacking personnel the importance of removing defective and decaying stickers. The lumber value saved should easily offset the expense of buying or producing new stickers. More care in sticker storage and handling could also prolong sticker life and quality.

Bulk-Piled Lumber

Stain was the most common defect found for all combined samples, yet only three operations accounted for 92 percent of all boards degraded by stain. These three yards received bulk-

Figure 5.—The drying efficiency of a yard depends to some extent on the yard's surface, especially its composition and how well it is graded and drained. If water stands in a yard after a rain, it will decrease the rate of drying in nearby stacks.

Figure 6.—Without an effective covering, lumber in the upper courses of an exposed package may warp, check, and split. The economic effect of unprotected lumber is particularly notable in the upper grades of hardwoods.

Figure 7.—A good, raintight roof cover can be constructed of loose sheets of corrugated metal tied to the package with "C" clamps. If used to protect the upper grades of factory lumber, the value and footage savings will more than pay for the materials after only a few uses.

piled, green lumber from local mills, and the lumber was not stickered fast enough to prevent the large-scale occurrence of stain throughout these bundles. In addition, this lumber was not treated with an anti-stain solution before finally being stacked for drying.

Fortunately, these plants can use stained lumber in their manufacturing process and do not regard stain as a serious defect. Unfortunately, the situation permits a large amount of potentially high grade material to be removed from the market where it might find higher end uses. This eventually impacts the standing timber resource as more trees must be harvested to meet the existing demand for higher grade lumber.

If we can assume that the inspected operations are fairly representative of the industry's practices as a whole, there is much room for improvement. Individual plants could realize a significant savings in air-drying costs by improving present yard conditions and adopting practices that reduce needless degrade. At today's market prices for high quality hardwood lumber, a nominal investment in improvements could quickly provide greater returns. Reducing the amount of controllable degrade can do nothing but improve the quality, and dollar value, of the finished product.

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